



## King County EMS

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1st Edition  
January 2004

# CBT 301 Soft Tissue Injuries

## Course Supplement



# Intro

Soft tissue is a term that encompasses all body tissue except the bones and includes skin, muscles, vessels, ligaments, tendons, nerves and organs. Soft tissue injuries can range from the trivial (a scraped knee) to the critical (internal bleeding).

## Resources

The recertification exam for this module is based on a variety of resources. We recommend that you review the following:

Chapter 24 – Soft Tissue Injuries - *Emergency Care and Transportation of the SICK and Injured*, 8th ed.

King County EMS *Patient Care Guidelines for BLS* (10/02 ed.) pages 2.1-2.3, 3.7-3.9, and 3.19-3.20.

This course also has a hands-on practical skills component.

Up-to-date CDC blast injury information

<http://www.cdc.gov/masstrauma/preparedness/primer.htm>

## Objectives

CBT 301 is an EMT continuing education and recertification course. After completing this course you will be able to:

1. Identify the functions and layers of the skin.
2. Identify the types of closed and open soft tissue injuries.
3. Identify the factors to consider in assessing MOI.
4. Identify the statement that best explains the kinetic energy as it relates to MOI.
5. Identify the correct technique for assessing CMS.
6. Demonstrate knowledge of assessment of soft tissue injuries including recognition of related signs and symptoms.
7. Identify the emergency medical care for a patient with a closed soft tissue injury.
8. Identify the emergency medical care for a patient with an open soft tissue injury.

# Terms

**abrasion** – Damage to the superficial layer of skin as a result of rubbing or scraping across a rough or hard surface.

**avulsion** – Soft tissue that is either torn completely loose or is hanging as a flap.

**body substance isolation (BSI)** – An infection control concept and practice that assumes that all body fluids are potentially infectious.

**compartment syndrome** – An elevation of pressure within the compartment that contains muscles, nerves, and vessels. For example, the lower leg has compartments in the front, back, and side. Patients with compartment syndrome have skin that is very sensitive to touch or pressure, pain on stretching of affected muscles, and decreased strength. It is most common in the lower leg and usually develops several hours after an injury.

**contusion** – A traumatic injury to the tissues beneath the skin without a break in the skin.

**DCAP - BTLS** – A mnemonic for assessment in which each area of the body is evaluated for Deformities, Contusions, Abrasions, Punctures/Penetrations, Burns, Tenderness, Lacerations, and Swelling.

**dermis** – The inner layer of skin containing hair follicles, sweat glands, nerve endings, and blood vessels.

**DICES** – An acronym used to remember the treatment of soft tissue injuries. *Direct pressure* over the open wound with your gloved hand. *Ice* or cold pack (closed soft tissue injuries) slows bleeding by causing blood vessels to constrict and also reduces pain. *Compression* over the dressing with a roller bandage slows bleeding by compressing the blood vessels. *Elevation* of the injured part just above the level of the patient's heart decreases swelling. *Splinting* decreases bleeding and also reduces pain by immobilizing a soft-tissue injury or an injured extremity.

**dislocation** – An injury that occurs when the bone ends that form a joint become separated. For example, a dislocated shoulder.

**ecchymosis** – Discoloration under the skin that is caused when blood leaks out into the surrounding soft tissues causing the skin to turn different colors. A “black eye” is ecchymosis under the skin around and below the eye.

**edema** – Swelling as a result of inflammation or abnormal fluid under the skin.

**epidermis** - The outer layer of the skin that keeps you waterproof.

**exsanguination** – Term associated with soft tissue injuries meaning “to be drained of blood.”

**fascia** – A band of tough fibrous connective tissue. It lies deep under the skin and forms an outer layer for the muscles. Think of it as the sac than holds the muscle fibers.

**hematoma** – Blood collected within the skin, muscles or in a body cavity. A large hematoma can be seen or felt. “A lump on the head following a bump on the head is a hematoma under the skin.”

**hemophilia** – A congenital condition in which the patient lacks one or more of the blood’s normal clotting factors.

**hemorrhage** – Another term for bleeding.

**hypotension** – Blood pressure lower than normal range (systolic BP less than 90 mmHg).

**hypovolemic shock** – Shock (inadequate tissue perfusion) due to loss of fluid or blood.

**infection** – The presence of bacteria, viruses, or parasites, that causes infectious disease.

**laceration** – A cut in the skin.

**mucous membrane** – Soft, moist linings of airways, GI tract and reproductive tract. Your mouth, for example, is filled with mucous membranes

**plasma** – A sticky, yellow fluid that is part of blood. If you remove the red blood and white blood cells from blood you are left with plasma.

**platelets** – Tiny, disc-shaped elements that are much smaller than red or white blood cells, and help in the formation of a blood clot,

**pressure point** – Point where a blood vessel lies near the surface and can be compressed over a bone.

**red blood cells** – Cells that carry oxygen to the body’s tissues; also called erythrocytes.

**shock** – A condition that is caused by inadequate tissue perfusion. It usually develops when the circulatory system is not able to deliver sufficient blood to body organs.

**shock position** – (Trendelenburg position) A body position that has the legs and lower torso elevated 8 inches to 12 inches to help increase blood flow to the brain.

**subcutaneous tissue** – A layer of tissue, composed largely of fat, that lies directly under the dermis.

**sprain** – A joint injury involving damage to supporting ligaments and partial or temporary dislocation of bone ends.

**strain** – Stretching or tearing of a muscle; also called a muscle pull.

**superficial** – Closer to or on the skin.

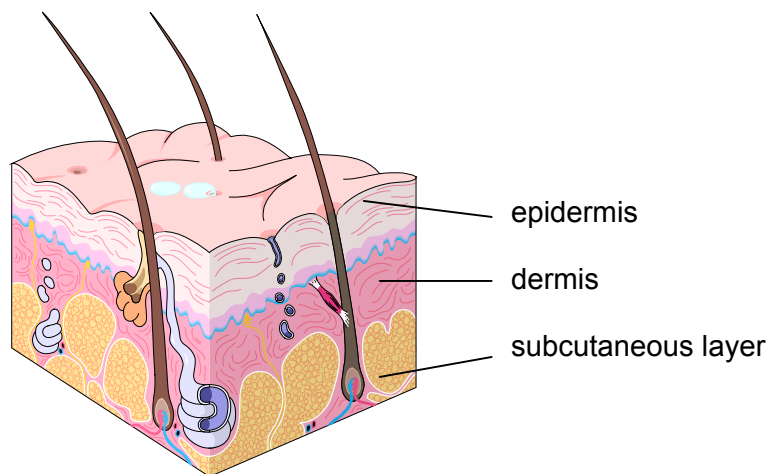
**white blood cells** – Cells that play a role in the body’s immune defense mechanism against infection. They are also called leucocytes.

# Anatomy

The skin is the largest organ in the body. It protects against heat, light, injury and infection. It also regulates body temperature; provides sensory input for heat, touch and pain; and stores water, fat and vitamin D.

The skin has three layers:

- epidermis
- dermis
- subcutaneous layer



The **epidermis** is the thin outer layer of the skin. This layer contains cells that continually divide, forming new cells and replacing the old ones that are shed from the surface of the skin.

The **dermis** is the layer below the epidermis. It contains:

- blood vessels
- lymph vessels
- hair follicles
- sweat glands

The dermis is held together by a protein called collagen that gives the skin its strength and resilience. This layer also contains pain and touch receptors.

The **subcutaneous layer** is the inner layer and consists of a network of collagen and fat cells. It helps conserve heat and protecting internal organs from injury by acting as a shock absorber.

# Closed Soft Tissue Injuries

A closed soft tissue injury is an injury to the tissues beneath the skin where the skin or mucous membrane remains intact. The extent of damage may not be readily visible. Swelling, bruising, immobility and pain at the injury site may indicate a closed injury. You will often find closed injuries in accidents where a significant mechanism of injury was involved.

There are six types of closed soft tissue injuries.

- Contusion
- Hematoma and edema
- Sprain
- Strain
- Dislocation
- Crush injury

**Contusion** is the medical term for a bruise that results from a blunt force applied to the soft tissues of the body. It may involve the skin, muscles or other soft structures. The injury may result in damage to the soft tissues, swelling and pain.

If blood leaks out into the soft tissues in a contusion it may lead to discoloration and the skin may turn black or blue in color. The term for such discoloration under the skin is ecchymosis.

A **hematoma** is a collection of clotted blood under the skin. It can occur in any soft tissue such as skin or muscle. A hematoma is caused when blood leaks from an injured vessel.

Injury to soft tissues from blunt force leads to swelling and edema. **Edema** is the medical term for swelling as a result of fluid in the skin or muscle. If the swelling becomes great enough it may put pressure on blood vessels and nerves. Edema is more likely to occur in the lower legs because there isn't much room for the muscles to swell. The muscles in the lower legs are covered by fibrous tissue called fascia. Fascia are not very elastic.

A **sprain** is a joint injury involving damage to supporting ligaments and partial or temporary dislocation of bone ends. Pain and swelling are often seen with this type of injury.

A **strain**, on the other hand, involves stretching or tearing of a muscle. It is also called a "pulled muscle."

A **dislocation** occurs when the bone ends that form a joint become separated. Dislocations occur in moving joints such as shoulder, elbow, fingers, toes, knee, ankle, and hip joints. The shoulder is the most commonly dislocated major joint.

Dislocated joints are very painful (especially large joints) and a patient generally will hold the extremity in the most comfortable position possible. Do not attempt to move the joint unless there is a good reason to do so, for example, the lack of distal pulse or sensation. A patient with a dislocated joint will often have an associated fracture of the nearby bone.

Shoulderdis.jpg

**Crush injuries** are associated with significant mechanisms of injury. If a force is great enough, soft tissue (muscles, vessels, skin) can be crushed leading to extensive tissue damage and subsequent swelling and pain. Crush injuries in the lower extremities and forearm can lead to *compartment syndrome* that generally takes a few hours to develop.

When assessing trauma, you should always suspect injury to soft tissues and organs beneath the area of impact or observable surface injuries. For example, a baseball bat to the abdomen may cause a bruise over the umbilicus, but this mechanism might also damage the underlying organs such as the stomach, bowel, pancreas, spleen and liver. This may seem like common sense, but all health professionals are prone to tunnel vision. Seeing the obvious can make you forget about the unobvious.



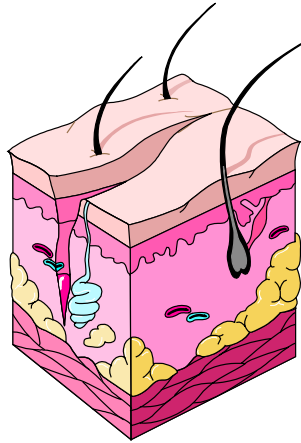
# Open Soft Tissue Injuries

An open soft tissue injury is an injury where the surface of the skin or the mucous membrane is broken, exposing underlying deeper tissue. This type of injury requires a thorough assessment and appropriate BLS care.

There are four types of open soft tissue injuries:

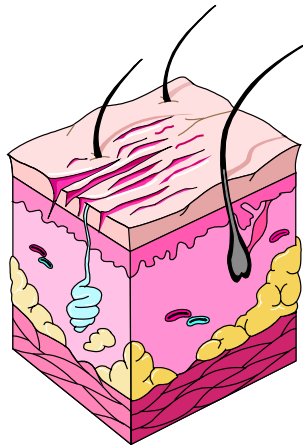
- Laceration
- Abrasion
- Avulsion
- Amputation

**Lacerations** are cuts. Cuts come in all sizes and shapes and can penetrate beneath the skin into the subcutaneous tissues and muscles.



**Laceration**

**Abrasions** are the result of friction across the skin. A good example of an abrasion is a scraped knee from falling on asphalt.



**Abrasion**

An **avulsion** occurs when soft tissue is either torn completely loose or is hanging as a flap. It is generally a piece of skin, but if severe enough can extend into the subcutaneous tissue or even muscle. Avulsions can bleed heavily because of the deep tissue destruction. The deeper the injury, the larger are the blood vessels which increases bleeding.

An **amputation** is the complete separation of a protruding body part such as a finger, toe or limb. Traumatic amputations may result directly from a variety of mechanisms including power tool, farm equipment and motor vehicle accidents. Partial amputation is also possible where some soft-tissue remains connected to the body. Depending on the severity of the injury, the amputated extremity may or may not be able to be reattached.

# Mechanism of Injury

Mechanism of injury (MOI) is a term that is used when talking about the size, direction and character of a force that causes injury. Your observations of the MOI are an important element in a patient's care. There are seven factors to consider when assessing MOI.

Factor	Examples
Speed	motor vehicle versus bicycle rider was not wearing helmet driver was wearing safety belts vehicle airbags deployed
Height	patient became dizzy and fell from standing height victim was pushed from height of 12 feet and landed on concrete floor
Weapon type and size	12 gauge shotgun high-powered rifle-exit wound on patient's back patient was stabbed with a 3 inch paring knife patient impaled hand using air-powered nail gun (2 inch nails)
Direction	patient's ankle twisted outward
Type of bite	patient was bitten by human possible spider bite
Sound heard	patient heard a pop on impact patient describes hearing crunching sound when he landed on his leg



# Speed Kills

Traumatic injury occurs when the body is exposed to force beyond its tolerance. The energy of a moving object is called **kinetic energy** and is calculated as follows:

$$\text{Kinetic Energy} = \frac{\text{Mass} \times (\text{Velocity})^2}{2}$$

mass = weight

velocity = speed

The law of kinetic energy says:

- If you double the weight of a moving object the force doubles
- If you double speed the force **quadruples**

In other words, **speed kills**. The amount of kinetic energy or force that is delivered to a human body dictates the severity of the injury. Therefore, speed is a very important factor in evaluating mechanism of injury.

# Focused History (Subjective)

SAMPLE is a mnemonic for the questions to ask when conducting focused medical history. It organizes the information you gather from the patient or bystanders in a logical format.

Symptoms	Identify the patient's chief complaint  <ul style="list-style-type: none"> <li>• What happened to the patient?</li> <li>• What are the specific circumstances surrounding the chief complaint?</li> <li>• Is the MOI significant?</li> </ul>
Allergies	Particular to medications
Medications	Prescription, over the counter, and recreational (illicit) drugs
Past history	Medical conditions (hemophilia, etc...)
Last oral intake	Include food and/or drinks
Events leading up to the incident	Include precipitating factors

# Physical Exam (Objective)

The detailed physical exam should be conducted in a systematic manner and should focus on the chief complaint; however, when there is a significant MOI, you should immediately perform a rapid trauma assessment to assess for obvious or life-threatening injuries. If time permits, conduct a detailed physical exam or neck/head-to-toe exam by palpating and viewing all planes of the patient's body. You will also need to collect and document baseline vital signs.

## Signs/Symptoms of Soft Tissue Injury

- Bleeding (internal/external)
- Pain and tenderness
- Limited movement
- Deformity or angulation
- Discoloration
- Swelling
- Crepitus
- Absence of distal pulses
- Absence of distal motor function or sensation

## Soft Tissue Injuries Involving Joint Structures

It is often difficult for an EMT to distinguish sprains and strains from dislocations. Keep in mind that dislocations are far more serious injuries that require prompt attention.

### Sprain/strain

- Relevant mechanism of injury
- Point tenderness of injured joint/ligament
- Swelling and ecchymosis of injured joint
- Pain causing immobility
- Instability
- Guarding during joint motion

### Dislocation

- Relevant mechanism of injury
- Marked deformity of joint
- Swelling
- Pain aggravated by movement
- Tenderness of palpation
- Loss of normal joint motion
- Numbness
- Impaired circulation to the limb

# Assessing CMS Function

Important blood vessels and nerves lie close to the bone, especially around the major joints. Assess circulation, motor, sensory function (CMS) as part of the detailed physical exam.

<b>Circulation</b>	palpate the pulse distal to the point of injury check skin color or capillary refill time
<b>Motor</b>	evaluate muscular activity
<b>Sensation</b>	check for feeling and the patient's ability to sense light touch

If you suspect that a joint is dislocated, you should assess distal nerves and vessels function by checking CMS. Repeat every 5 to 10 minutes and document the results of your assessment.

If the limb has lost circulation, motor or sensory function, attempt to reposition the dislocated joint then reassess CMS and note improvement.

# Assessment

Based on the patient's chief complaint and mechanism of injury you should be able to form a general impression or "best guess" as to what you think the problem is. The information gathered from a focused history and physical exam should support the impression.

## **BLS Indicators**

- Conscious and alert
- Stable vital signs
- Soft tissue injury limited to the dermis and epidermis
- Single digit amputations
- Soft tissue injury with distal pulse intact
- Soft tissue injury with bleeding controlled by direct pressure or elevation

## **ALS Indicators**

- Significant head injury
- Signs and symptoms of shock
- Soft tissue injuries involving the airway, with excessive bleeding
- Important co-morbidity (e.g., hemophilia)

Before requesting a medic response consider whether ALS intervention will improve the patient's condition. Do you think a medic assessment or advanced interventions such as intubation, IV therapy or drugs are needed?

**Request a medic unit for all unconscious patients.**

Special Note: The initial assessment and the SICK or NOT SICK decision may be made within 60 seconds, however you should frequently reevaluate the patient.

EMTs are not expected to make accurate diagnoses in the field and the language you use in your reports will reflect that your assessment is only an impression based on the evidence you collect (MOI, c/c, signs and symptoms). Here's some terms that may help you in expressing your general impression.

- Possible (e.g., possible fracture)
- Suspected (e.g., suspected dislocation)
- Potential (e.g., potential internal injury)



# Treatment of Closed Injuries (Plan)

BLS providers have various treatment options at their disposal for the care of soft tissue injuries. The following are guidelines for the care of closed injuries.

<u>Type of Injury</u>	<u>Signs/symptoms</u>	<u>Treatment</u>
Contusion	pain and bruising	reassure patient
Ecchymosis	blue/black discoloration	immobilize
Hematoma	pain, swelling and discoloration	ice or cold pack
Edema	pain, swelling and possible loss of function	elevate
		splint
Sprain	mechanism of injury	reassure patient
Ankle	anxiety	gently support the site
Wrist & Hand	point tenderness	note and record CMS
Elbow	swelling and ecchymosis	apply ice pack to sprained area
	pain preventing movement	splint and immobilize injured limb
	instability of joint	elevate injured limb
	guarding	arrange for transport to appropriate care center
Strain	mechanism of injury	reassure patient
<i>Back</i>	anxiety	gently support the site
<i>Neck</i>	point tenderness	note and record CMS
<i>Muscle</i>	swelling and ecchymosis	apply ice pack to sprained area
	pain preventing movement	splint and immobilize injured limb
	instability of joint	elevate injured limb
	guarding	arrange for transport to appropriate care center
Dislocation	mechanism of injury	reassure patient
<i>Shoulder</i>	anxiety	gently support the site
<i>Knee</i>	marked deformity	note and record CMS
<i>Elbow</i>	swelling	apply ice pack to sprained area
	pain aggravated by movement	splint and immobilize injured limb
	tenderness on palpation	elevate injured limb
	virtually complete loss of normal joint motion (locked joint)	mandatory transport to hospital emergency room
	numbness or impaired circulation	

Special Note: Treat hip dislocations as fractures.

# Treatment of Open Injuries (Plan)

The following are general guidelines for the care of open injuries.

- Assess level of consciousness
- Maintain an open airway
- Ensure adequate breathing
- Control bleeding
- Provide warmth (aid car temp 70° F)
- Request ALS for unconscious patient
- Provide cervical spine stabilization
- Administer oxygen
- Inspect for entrance and exit wounds

Large, easily removed debris, such as glass, splinters or gravel can be removed before bandaging. Large, deeply imbedded fragments or projectiles should be secured in place by the bandage. Do not rub, brush or wash an open wound because it may cause additional bleeding.

## DICES

DICES is a mnemonic for the steps in the treatment of an open soft tissue injury.

<b>Direct pressure</b>	Apply direct pressure over the open wound with your gloved hand, and then apply a dry, sterile compression dressing over the entire wound. Maintain pressure with a roller bandage. If bleeding continues or reoccurs, leave the original dressing in place and apply a second dressing on top of the first, and secure it with another roller bandage.
<b>Ice or cold pack</b>	Apply an ice pack or cold pack (for closed soft tissue injury only) to slow bleeding by causing blood vessels to constrict and also reduce pain.
<b>Compress</b>	Compress down over the dressing with a roller bandage to slow bleeding by compressing the blood vessels.
<b>Elevate</b>	Elevate injured part just above the level of the patient's heart to decrease swelling. Use pressure point if bleeding continues.
<b>Splint</b>	Splint and immobilize all soft-tissue injuries to decrease bleeding and also reduce pain

# Amputation Instructions

Amputations and avulsions may require control of bleeding in which case you would use direct pressure or pressure points. Use a tourniquet only as a last resort for severe life threatening bleeding as characterized by hypotension.

Wrap amputated parts in dry sterile dressings and place the amputated part in a watertight container. Then place the watertight container in a second container that should be place on ice.

**Do not submerge** the amputated part in water or place directly on ice. **Do not use dry ice** to cool a severed part; however, ice or chemical cold packs are acceptable.

Rapid transport of the patient and the severed part is critical to the success of re-implantation. If transport of the patient is delayed, consider sending the amputation ahead to be surgically prepared.